Building an National Robotics Program

Robotics in the United States of America

Robotics - VO

Henrik I Christensen
KUKA Chair of Robotics

Georgia Institute of **Tech**nology®

Rensselaer

Carnegie Mellon

JOHNS HOPKINS
U N I V E R S I T Y

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UNIVERSITY of PENNSYLVANIA

THE
UNIVERSITY
OF UTAH

USC
UNIVERSITY
OF SOUTHERN
CALIFORNIA

UMASS
AMHERST

THE TECHNOLOGY COLLABORATIVE
Accelerating Digital & Robotic Innovation.

CCC - Roadmap

- Effort to investigate a roadmap for robotics in US

- What are the promising opportunities/applications

- What are the main obstacles to progress?

- What are the key science challenges?

- What is a good strategy to make progress?

Road-mapping?

- Will investments in robotics pay off?

Background Analysis

Sector	Average Growth	Growth
Robotics – manufacturing, service and medical	20%	0-120%
IP Companies	21%	15-26%
Healthcare/eldercare	62%	6-542%
Entertainment/toys	6%	4-17%
Media / Games	14%	2-36%
Home appliances	1%	-4-7%
Capital equipment	8%	-4-20%
Automotive	0%	-11-13%
Logistics	21%	4-96%
Automation	4%	2-8%

Consolidated annual growth rates over a set of 280 U.S. companies for the period 2004-2007.

Robotics and Intelligent Machines @ Georgia Tech

Driving Research?

Researcher → Basic Research → Transition → Development → Market Development

Researcher → Basic Research ← R&D Definition ← Application Design ← Market Need

Customer → Market Need → **Businesses Businesses Businesses** → Business Plan(s) → Technology gaps → Research Agenda → **Researcher**
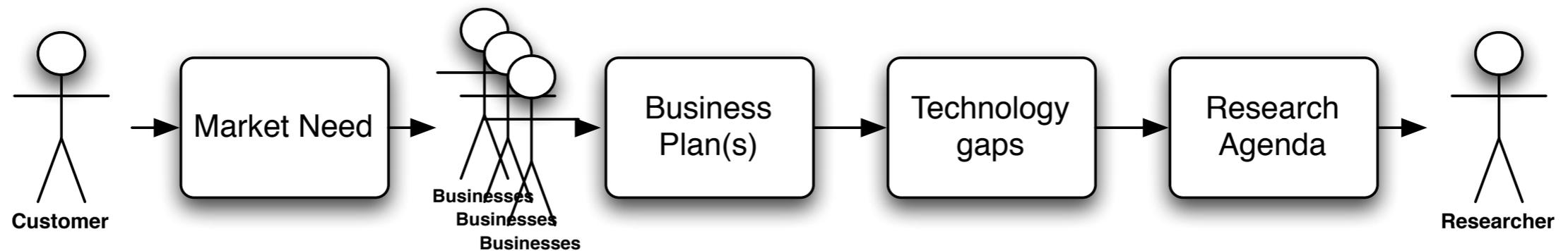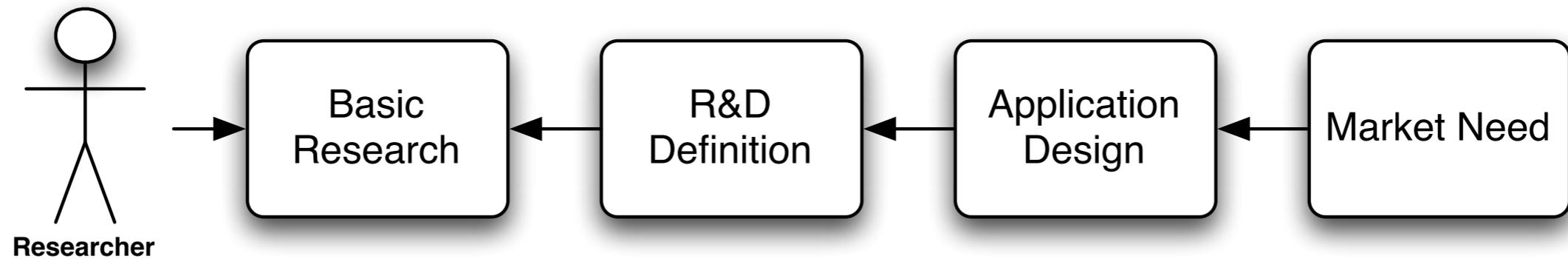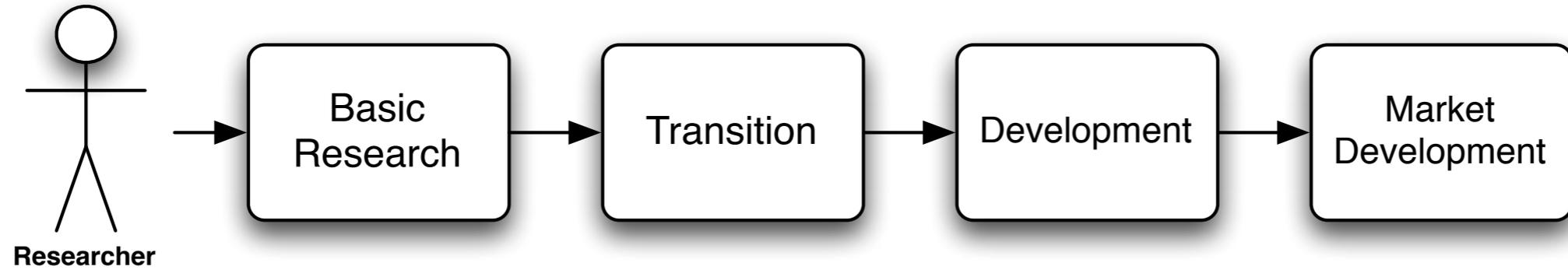
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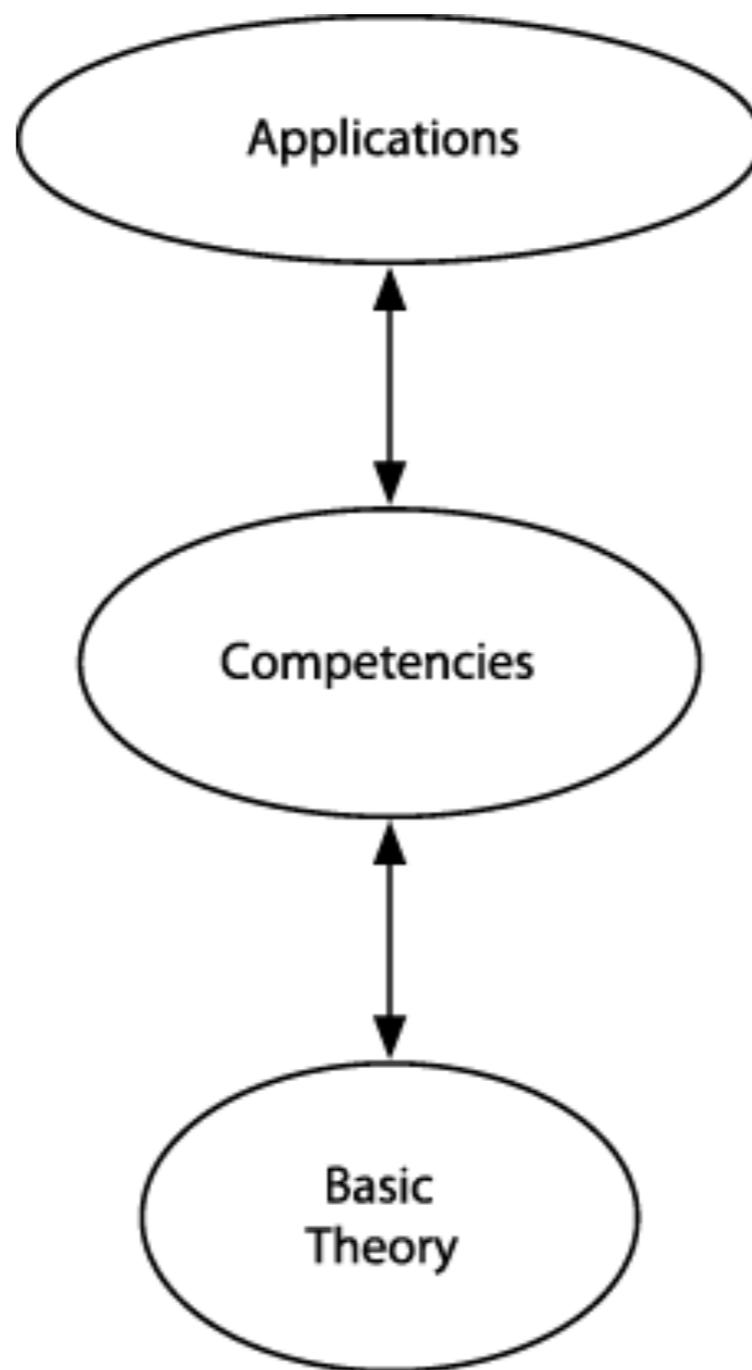
4 topical workshops

- Manufacturing & Logistics
  - Trinkle, Kumar, Goldberg, Christensen
- Service Robotics
  - Brock, Thomasmeyer, Christensen
- Medical / Healthcare
  - Mataric, Okamura, Christensen
- Emerging Technologies
  - Mason, Hollerbach, Christensen

Synthesis?

Organization

Congressional Caucus on Robotics

⬆

National Leadership Panel

⬆

CCC Committee on Robotics

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| Manufacturing & Logistics | Service Robotics | Medical & Healthcare | Emerging Technologies |
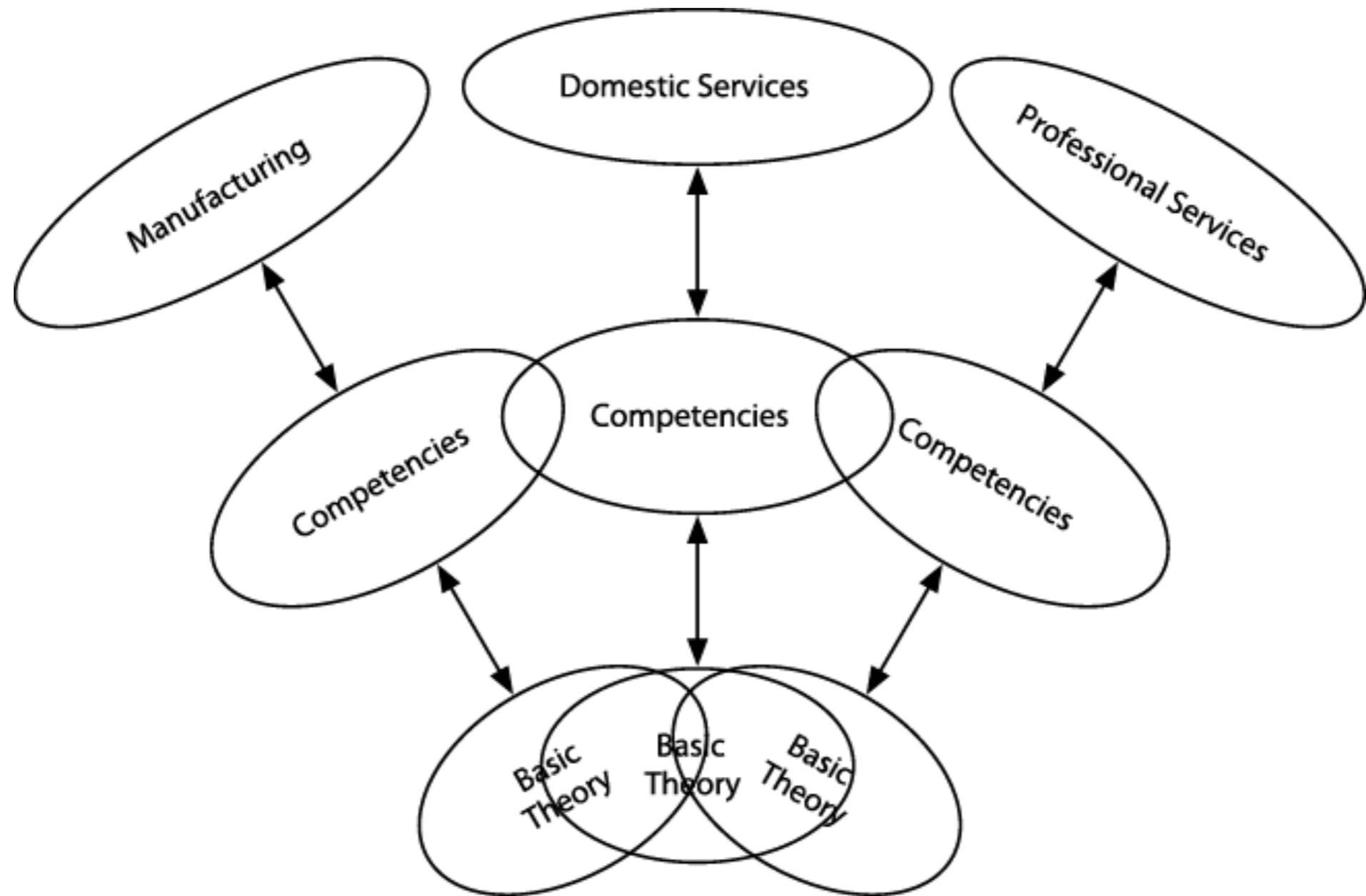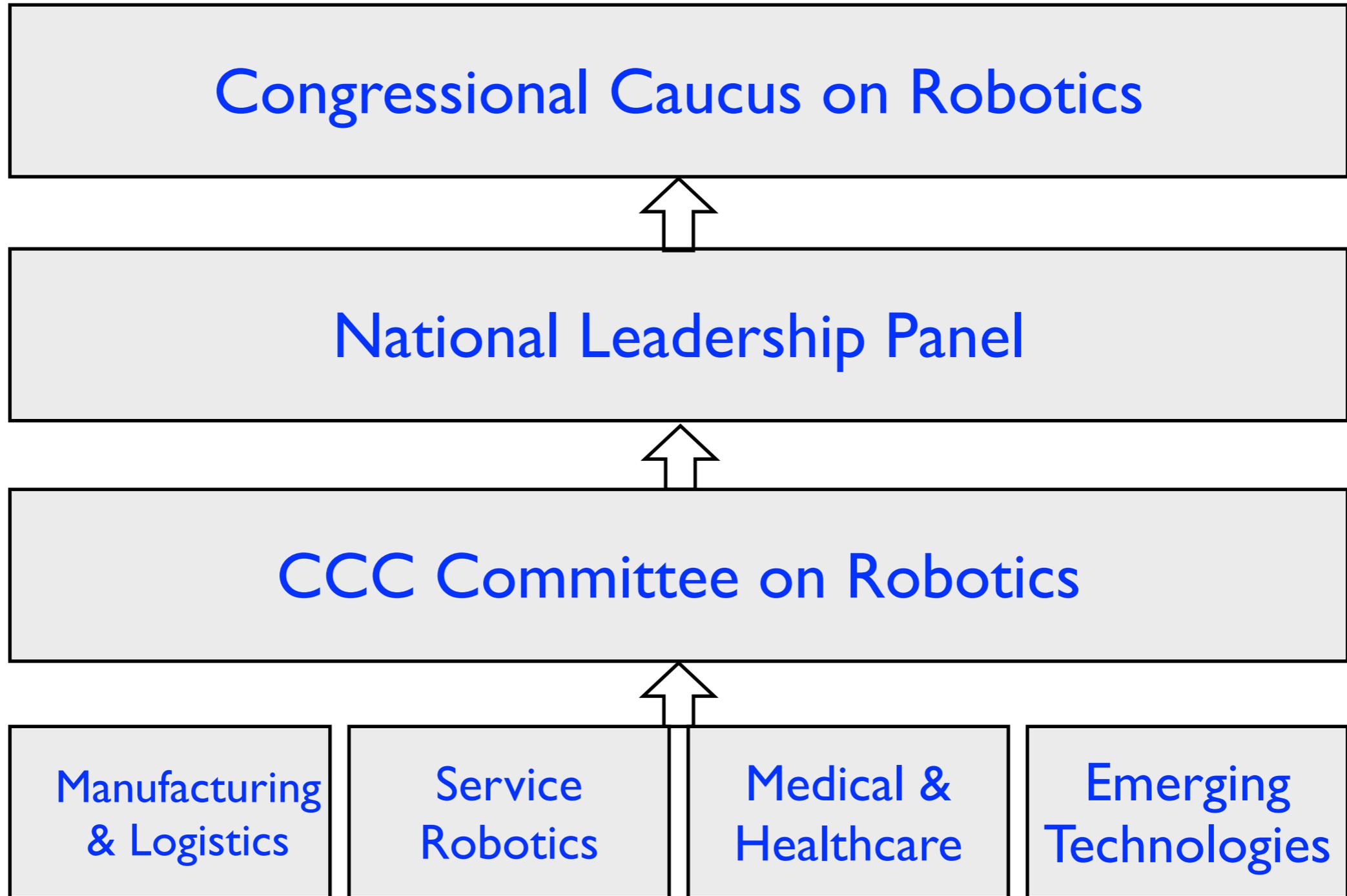
Timeline

March 08	Start of Effort, Call for Proposals
June/Aug 08	Workshops
Oct 08	Draft Topical Roadmaps
Dec 08	Completed Roadmap Draft
Mar 09	Community Feedback
May 09	Presentation to Congress
Jul 09++	Agency Discussions
Fall 09	Discussion of Programs
2011	Launch of Efforts

Societal Drivers

% of population above 65 (UN 2008 Data Series)

Legend: WesternEurope — USA — Japan — India
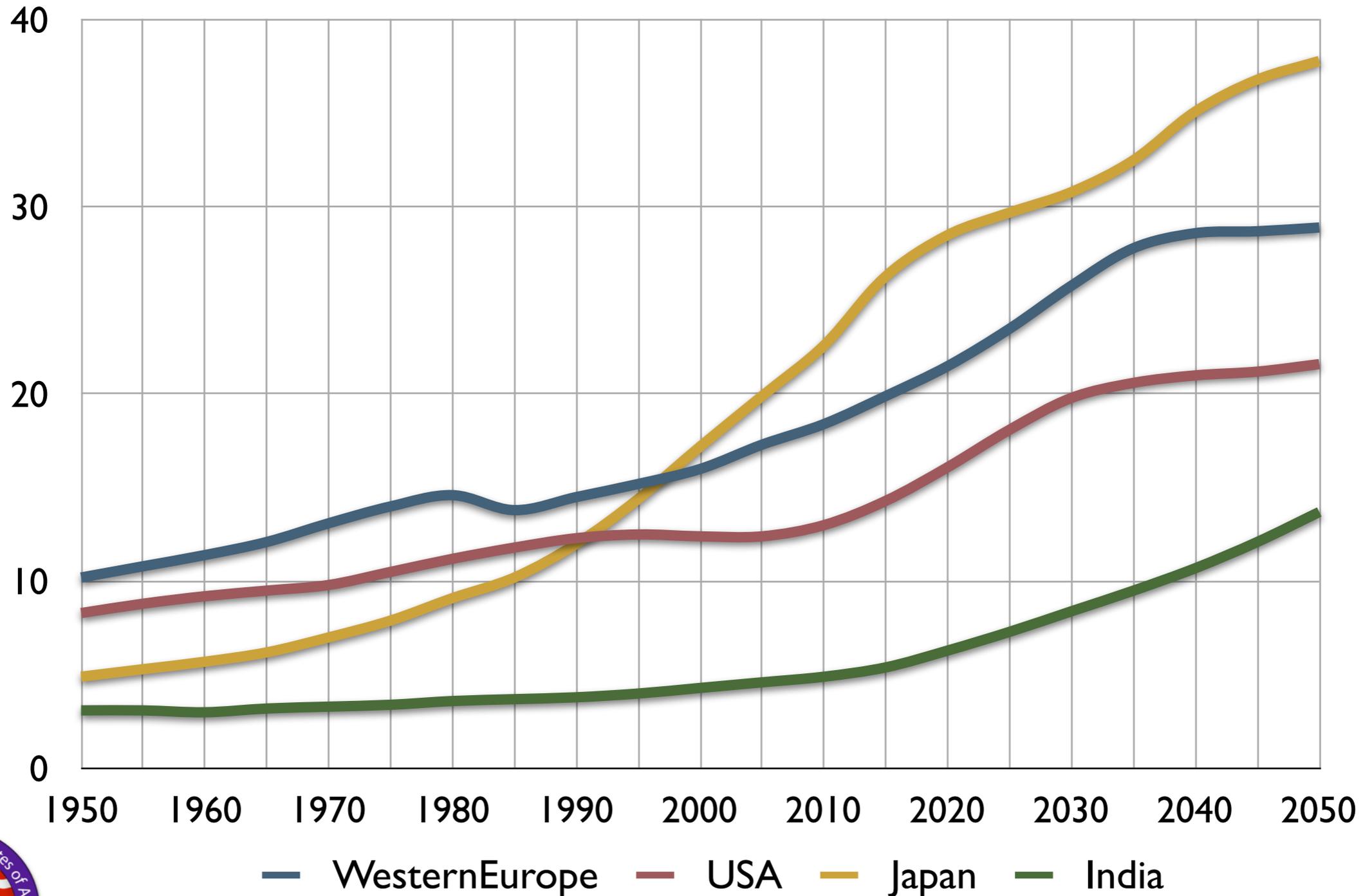
Analysis for each area

- Economic / Societal Drivers

- Core capabilities needed for applications

- R&D challenges
  - 5, 10 and 15 year expectations

Manufacturing

- Large Scale Manufacturing

- Lack of SME Focus

- Flexibility is key to progress

- Logistics is major target

- Process consideration is key

- Perception, Learning & Safety

Manufacturing
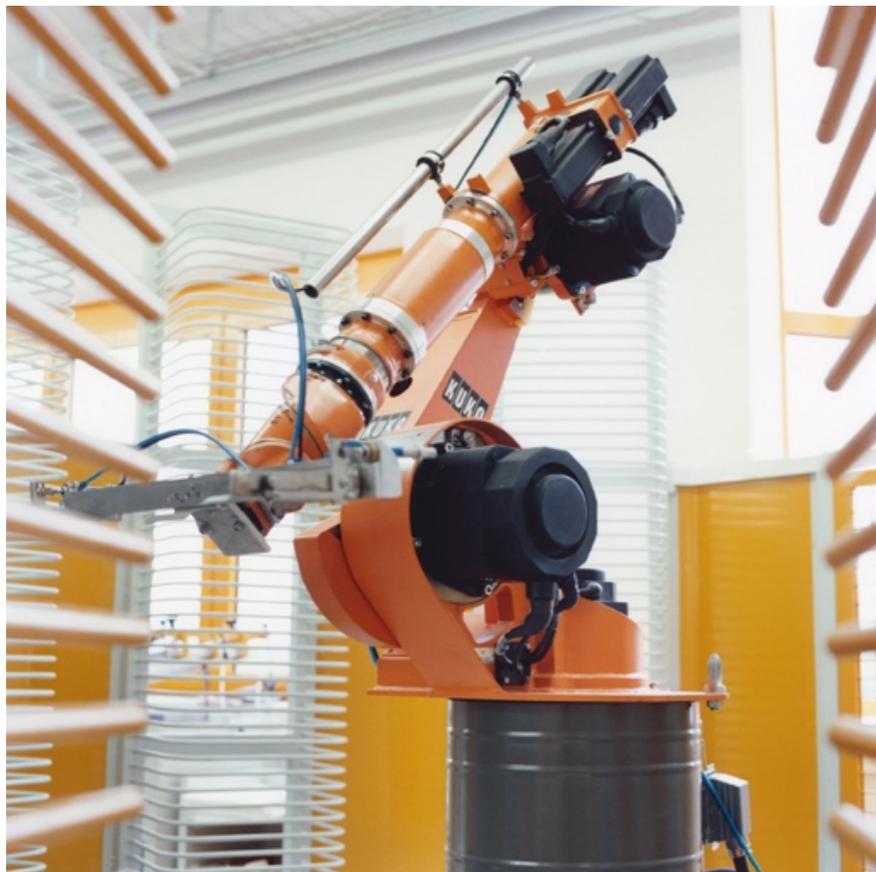
- ~11% of GDP (significant overall impact)

- Focus has been on large scale manufacturing

- "Bring manufacturing home"

- Empower small and medium sized companies

- Simplified use, added flexibility & versatility

Logistics

- All consumer goods are on a truck at least once!

- < 15% of process has been automated

- The transport cost could be reduced by 20-30% or ~5% of final cost and energy

- Flexible palletizing. Ease of programming, small series delivery tasks, ...

Issues

Technologies

Architecture and representations

Control and planning

Formal methods

Learning and adaptation

Modeling, simulation and analysis

Novel mechanisms and high-performance actuators

Perception

Physical human-robot Interaction

Robust, high-fidelity sensors

Socially-interactive robots

Critical Capabilities

Perception to enable operation in unstructured environments

Human-like dexterous manipulation

Adaptable and reconfigurable assembly

Robots working with humans

Autonomous navigation

Rapid deployment of assembly lines

Green manufacturing

Model-based integration and design of supply chain

Interoperability of component technologies

Nano manufacturing (next-generation products)

Manufacturing Domains

Mining

Processing

Discrete-part manufacture

Assembly

Logistics (transportation, distribution)

Co-X: Robot as human-robot cooperators

- Co-Worker
  - Manufacturing, Logistics, Medical Application
- Co-Inhabitants
  - Elderly care, home assistance, safe driving
- Co-Protectors
  - Defense and home-land security applications

Co-Workers

Next Generation Co-Workers?
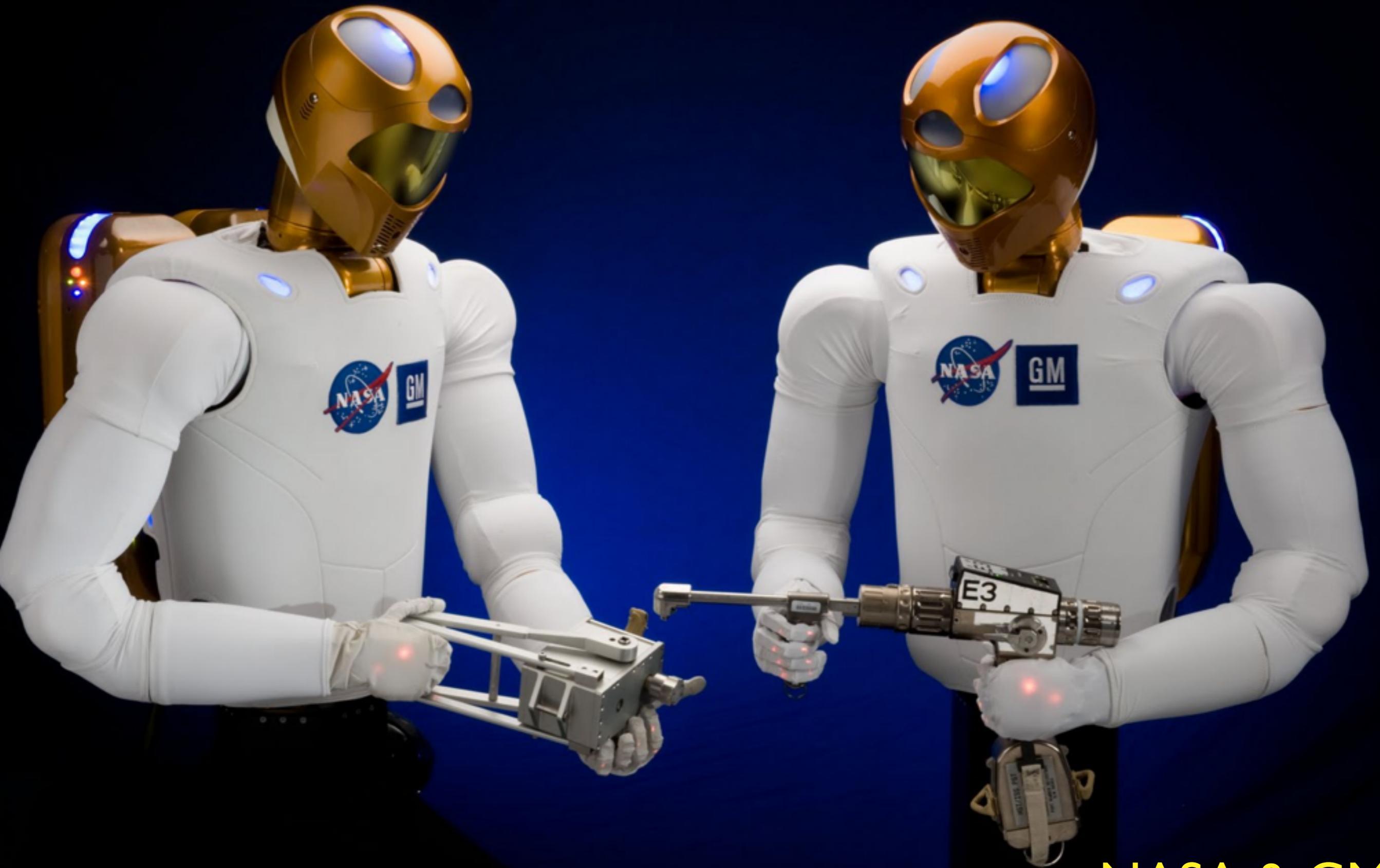
NASA & GM

Co-Workers

Co-Inhabitants

Wakamura

Co-Inhabitants

Cleans under and around furniture, using its light-touch bumper to gently touch and move around the obstacle.

Automatically avoids stairs and drop-offs.

Self-adjusts from carpets to hard floors and back again.

Co-Inhabitants

Key Capabilities

- Adaptable & Reconfigurable Manufacturing

- Autonomous Navigation

- Green Manufacturing

- Human-Like Dextrous Manipulation

- Model Based Integration and Design of Supply Chain

- Nano Manufacturing

- Safe Manufacturing

Robotics@GT
& Intelligent Machines

NRI - Organization

- Making a clear cut plan for moving forward
  - $, problems and a strategy
- Engaging the political actors early
- Push by NSF (& OSTP)
- Program is now $50-70M/yr
- Other programs also getting launched
  - Defense, Equipment, Commerce, ...

Moving forward

- Academia / Industry / Government alliance

- Pushing for a broad agenda

- Roadmap has many of the details
  - http://www.us-robotics.us

- Creation of coordination across agencies and industries

  - National Summit on Robotics across agencies

NATIONAL Robotics WEEK

INNOVATION • TRANSFORMATION • EDUCATION

- 2nd week of April every year

- Defined/written into law by the US congress

- Broad set of activities

- www.nationalroboticsweek.org

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- A national network for robotics - Robotics-VO

- Roadmapping & agency coordination

- Education and Training

- Tech-Transfer

- Dissemination and Press

- {and Administration}

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THANK YOU!